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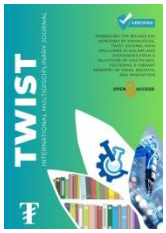

Exploring the Impact of Blended-Learning using Moddle on Students' Academic Achievement and Mathematical Attitudes

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Abstract
In recent years, the advancement of science and technology has spawned numerous multimedia learning platforms that can be accessed for free, thereby assisting students in developing their ability to comprehend science independently. Moodle is one of the platforms used by educators to deploy the blended-learning strategy. This study attempted to determine if a blended-learning strategy utilizing Moodle as a learning platform can have a positive impact on students' mathematical ability and attitudes. The study population included 26 boys and 59 girls with an average age of 14 years, while the research sample consisted of 10 boys and 17 girls selected using the cluster random sampling method. This study used a mixed-methods design. Following the implementation of a blended-learning strategy using the Moodle platform, the academic success of the students in mathematics was categorized as high. The application of Moodle in the classroom has a beneficial impact on students' mathematics academic achievement, as measured by an N-Gain score in the high range (0.6591). The use of Moodle as a learning medium can increase the interest and positive attitudes of students. Additionally, Moodle utilization also promotes active learning and interaction between students and the teacher in a learning environment.

Keywords
Blended learning, Moodle, Academic achievement, Learning environment, Mathematical attitudes

INTRODUCTION

The online education system has been implemented for approximately the last two years since the COVID-19 pandemic hit. Due to the fact that online education is a new policy, particularly in Indonesia, the online learning system undoubtedly faces hurdles (Laksana, 2021). Insufficient student comprehension is an example of a barrier to online learning (Wibawa & Suharjo, 2021). Not all material delivered online can be understood by students. This is a major issue, especially considering that two years have been spent building this system. Will the younger generation be permitted to pass an educational level without any provision of knowledge comprehension because they have surrendered themselves to a pandemic condition that makes it difficult to implement an excellent educational system?

As Indonesia's condition improves, so does the policy governing the learning system. In July 2021, the Minister of Education and Culture of Indonesia, Nadiem Makarim, emphasized that all schools must begin face-to-face learning in accordance with the Guidelines for Implementation of Learning in the COVID-19 Pandemic Period (PAUDDIKDASMEN) issued by the Ministries of Education and Religion. These standards include health protocols that must be completed before to and following learning, such as sanitizing the infrastructure and learning environment at an educational unit. In the post-pandemic era, we need a learning technique that can address student fear in order to solve

this issue. In addition to enforcing health guidelines, online learning also requires appropriate learning processes to assist student comprehension. In addition, it is vital to build a mechanism to help students transition from online learning to face-to-face learning. In other words, an efficient learning system must be implemented following the COVID-19 pandemic.

Didactic teaching is one of the most common approaches utilized in large-scale learning processes. The greatest obstacle, however, is the insufficient supervision of teachers, which reduces teacher participation in interactive learning. Blended Learning is one of the innovative learning strategies that can be used as a classroom-appropriate solution to this issue. A blended-learning strategy mixes conventional classroom instruction with an e-learning system (Muzaini et al., 2021;Y. W. Lin et al., 2017). With the implementation of the learning strategy, a teacher can conduct an initial learning session with students, who can then proceed to online learning interactions after gaining an overview of the topic being studied. If we can combine the benefits of each of these learning approaches, we can enhance the quality of education in schools.

When teachers give instructions to students who have learning difficulties in class, other students can work independently on content that requires simple reasoning and memory. Students can only attain learning objectives if they independently analyze, speculate, and investigate difficulties to obtain options or alternative answers to questions. Through blended-learning strategies, teachers can help students build independent learning, which is the foundation of creativity-enhancing motivation. With the advancement of science and technology in recent years, there are numerous free multimedia learning platforms that help learners acquire their ability to independently comprehend science. Moodle is one of the platforms used by teachers to execute blended-learning strategies. Moodle stands for Modular Object-Oriented Dynamic Learning Environment. It is based on the Course Management System (CMS) and facilitates e-learning by providing students with online group discussion and self-evaluation options. Moodle is a learning platform that can promote educational engagement and assist teachers in understanding students' personal abilities and academic accomplishments to enhance teaching quality and effectiveness. This study aimed to examine whether a blended-learning strategy employing Moodle as a learning platform has a favorable effect on students' mathematical abilities and attitudes.

Traditional Teaching

Traditional teaching includes content explanations and demonstrations, as well as setting up learning activities such as observations, experiments, activities outside the classroom, group discussions, practice, presentations, and question-and-answer sessions. Traditional instruction places an emphasis on classroom interaction, student participation in cooperative learning, and formative assessments such as quizzes and examinations, practice and school assignments, and assignment revision. After-school activities include writing project reports, conducting documentary research, and taking remedial courses (Lau, 2021).

In tough topics such as math and science, students who struggle frequently grow frustrated and discouraged. Traditional methods of education advance all students through the curriculum at the same rate, regardless of their content mastery (Hansson et al., 2021). In the classroom, teachers often lack the time to assist individual students, and students typically lack an in-house mentor. Consequently, students become frustrated because of incomplete homework assignments and subsequent low performance on the final examination. This recurrent onset will result in low academic self-efficacy and a loss of motivation and effort (Lau, 2021).

Blended Learning

Blended learning combines direct (synchronous) and indirect/independent learning methods or strategies (asynchronous). The blended-learning strategy is believed to be the best solution amid the COVID-19 pandemic. According to Firpo, (2016), blended learning is a combination of learning strategies, learning methodologies, and online and face-to-face learning. Anastasakis & Lerman, (2022) state that blended learning encompasses all teaching approaches that incorporate technology, such as e-mail, streaming media, and the internet, and can be coupled with traditional teaching methods.

In the United States, blended learning has been applied by some professors for face-to-face teaching by replacing one or two lessons from the weekly curriculum with e-learning (Conklina et al., 2017). According to research, significant academic progress occurs when traditional teaching is combined with computer-assisted instruction (Dalton & Hannafin, 1988). Therefore, traditional didactic teaching that complements computer-assisted teaching methods can be employed to teach mathematics for junior high school students.

Blended learning is intended to assist students in achieving their optimum learning objectives by utilizing a variety of instructional strategies, methods, and techniques. Blended learning consists of three elements: online learning, face-to-face learning, and autonomous learning (Keskin & Yurdugül, 2020). In addition to using computer-assisted instruction in the classroom, instructors can combine some components to improve traditional didactic teaching, which emphasizes student-centered learning. In this study, Moodle online learning refers to a pedagogy that mixes online instruction with traditional learning elements.

The Application of Moodle Instruction

Moodle is a free educational online application designed for e-learning (http://moodle.org). It is based on a social constructivist and constructionist approach to education that highlights the many ways in which students can participate to the educational experience (Suppasetseree, 2010). Moodle has adaptable layout, course administration, assessment

strategy quizzes, and cooperative learning (Y. W. Lin et al., 2017). The e-learning website notes that Moodle's functional modules include website management, learning management, course management, schoolwork module, charting module, voting module, forum module, test module, resource module, questionnaire module, and topic discussion module.
Using the Moodle learning platform, teachers can facilitate dynamic online group discussions, exams, and evaluations. The platform provides a mechanism to collect students' opinions and information about their learning process and assists teachers in understanding students' specific abilities and academic accomplishments to enhance the quality and effectiveness of instruction (Suppasetseree, 2010).

The "learner-centered" instructional model enables students to study Moodle without being limited by space, time, or distance. The use of computer-assisted online assessment not only reduces teachers' workload, but also satisfies the desire for immediate diagnostic results of student learning. Other additional benefits include consensus in environmental conservation, a reduction in the expense of paper-based examinations, an increase in teaching efficiency, and rapid student feedback (Handayanto et al., 2018).

Due to greater flexibility regarding place and time, computer-assisted teaching methods have emerged and altered the teaching approach in traditional classrooms in which the teacher imparts knowledge unidirectionally to the students. Combining scientific technology with education generates interactive discussions not only between teachers and students, but also between students, making the learning process active, multifaceted, and flexible (Ozdemir, 2010); enhancing the quality of learning; and encouraging students to engage in independent and responsible learning. In conclusion, computer-assisted instruction transforms students into active learners rather than passive consumers of knowledge (Baillie & Percoco, 2000); Qiao, 2021).

Moodle displays instructional resources with comprehensive explanations utilizing text, photos, and/or graphics (Kamaruddin, 2019). Students frequently misunderstand complex mathematical concepts in general. In this new era of superior digital technology, students must therefore reinforce their knowledge of mathematical principles using visual representations and visuals. Moodle facilitates face-to-face communication. Through the presentation of text and graphics as well as a link to the Internet, teachers can offer pupils with instructions or directives, so enhancing their capacity for comprehension. By converting graphics, graphs, charts, and photographs to a computer screen, teachers are constantly prepared to satisfy the needs of visual learners. (Schoevers et al., 2020). Using computer-mediated presentation, teachers can assist students in comprehending challenging abstract concepts and facts (Mahmoud & Auter, 2009) and stimulate students' interest and motivation to learn. Therefore, educators argue that computer-mediated instruction research should focus on learning attitudes and efficiency (Alavi et al., 2002).

Previous research has demonstrated the advantages of utilizing Moodle in junior high schools (Lu & Law, 2012 & White, 2010). Moodle has a pedagogical advantage because it was developed in accordance with an instructional strategy that promotes knowledge production through active and interactive learning and multimodal experience learning through multimedia. Moodle's design is based on socioconstructivist pedagogy (Thouësny & Bradley, 2011;Shachar & Neumann, 2010). The objective of developing Moodle was to provide a collection of tools that promote an inquiry-based or discovery-based approach to online learning and to facilitate the creation of online courses that enrich and supplement face-to-face classroom learning in a variety of ways. In addition, Moodle may build a collaborative interaction environment between students independently or through traditional classroom education, and it enables users to be active participants in the online learning process (Zakaria & Daud, 2013).

Prior studies have examined the efficacy of Moodle training. Research indicates that the Moodle learning platform can increase students' mathematics performance (Velinov, 2021; Awosdeyi et al., 2014). This method can help them easily grasp mathematics lessons and express their views on the content (Güzeller & Akin, 2012). In addition, it can boost students' enthusiasm and engagement (Martín-Blas & Serrano-Fernández, 2009; Parker & Martin, 2010; Shulamit & Yossi, 2011; Zakaria & Daud, 2013).

Academic Achievement

Academic achievement refers to the evaluation of a student conducted after the learning process. According to Piccoli et al., (2001), academic ability is typically examined via "tests." As a result, academic ability as measured by math accomplishment test scores is used as a dimension in this study to evaluate learning efficiency.

Mathematical attitudes

Emotions, attitudes, and beliefs are commonly seen as key determinants of the success of a learning process (Rahayuningsih et al., 2021; Rahyuningsih et al., 2022). One of the affective domains that get the attention of education practitioners is attitudes. According to Litster et al., (2021), an attitude is "an acquired inclination to respond positively or negatively to a specific object, circumstance, institution, or person." Consequently, attitudes influence what individuals do and reveal who they are; consequently, attitudes are a determining factor in people's conduct.

It is believed that attitudes play a crucial role in mathematics learning (Litster et al., 2021 ; Leavy et al., 2017; Tighezza, 2014). Among the different characteristics of students' emotional capacity, some researchers consider attitude to be an important aspect that must be taken into account while attempting to comprehend and explain the variation in student mathematical performance (Shahbari & Abu-Alhija, 2018; Smith et al., 2020; Larkin & Jorgensen, 2016).

A person's mathematical attitudes reflect their ideology, perspective, and practice about mathematics, or their affinity for mathematics (Cebesoy & Oztekin, 2018). Other scholars contend that mathematical attitudes include

mathematical beliefs and confidence (Smith et al., 2020). Using the vantage point of mathematics education psychology experts, this study splits its analysis of mathematical attitudes into six parts, namely a) confidence in learning mathematics, which refers to students' perspectives on their mathematical capacity and performance; b) attitudes toward success in mathematics, which refers to the expectation to succeed in mathematics; c) the usefulness of mathematics, which refers to students' perspective on the practicality of mathematics; d) motivation for exploring mathematics, which refers to students' active efforts to explore mathematics; and e) mathematics anxiety, which refers to students' apprehensions about mathematics (Fennema & Sherman, 1967) (Y. W. Lin et al., 2017); and (f) attitudes of significant others (e.g., parents and teachers) to mathematics, refers to the perceptions and expectations that parents and teachers have on students' performance in mathematics.

Field observations reveal that both teachers and students encounter difficult-to-solve challenges within the mathematics face-to-face education framework, particularly for novices. Students may have decreased interest, motivation, and a negative attitude toward mathematics. Moreover, significant others of students tend to pay little or no attention to their mastery of elementary mathematical ideas (Abramovitz, Berezina, Bereman, & Shvartsman, 2012) (Y. W. Lin et al., 2017). Thus, the employment of blended learning strategis can boost students' engagement and positive attitudes towards mathematics. Blended learning encourages active learning and interaction between students and learning facilitators. In addition, blended learning contributes to the diversification of instructional delivery in mathematics curricula and investigates the advantages of web-based technology in mathematical education (Awosdeyi et al., 2014). Blended learning boosts student accomplishment scores relative to other instructional methods (Awosdeyi et al., 2014) and has a positive impact on students' mathematical attitudes (Iozzi, & Osimio, 2012) (Y. W. Lin et al., 2017). In addition, students who participate in blended learning may benefit from a mediator since they spend more time studying at their own speed. Al-Quhtani and Higgins (Y. W. Lin et al., 2017) reported that blended learning can enhance student learning more effectively than e-learning or face-to-face learning alone (Awosdeyi et al., 2014). Combining online and face-to-face learning has many advantages over face-to-face learning or online learning alone (Means, Toyama, Murphy, Bakia, & Jones, 2009) (Parker & Martin, 2010).

Almost all empirical studies on the application of Moodle-based online learning and learning achievement have shown that the use of digital learning platforms results in higher achievement and is able to improve student learning attitudes (Mlotshwa & Chigona, 2018). However, research on the application of digital learning platforms and academic achievement has yielded inconsistent results: some students demonstrate improved learning performance (Chou & Liu, 2005); (Y. W. Lin et al., 2017) (Hung, 2007; Liu, 2010; Wang & Yu, 2012; Wiginton, 2013), whereas others did not experience a significant improvement (Hsu, 2010; Lin & Chen, 2007) (Y. W. Lin et al., 2017). Several prior studies on the association between gender factors and academic achievement revealed that women fared better than men (Chang, 2007; Chen, 2007), whilst other studies reported that males performed better than women (Fennema & Sherman, 1976; Lin & Chen, 2007; Sriampai, 1992). Some scholars contend that gender does not affect academic performance (Chen, 2012; Corbo, 1984; Li, 2010; Lindberg, Hyde, Petersen, & Linn, 2010; Liu, 2010; Samuels, 1983; Scafidi & Bui, 2010). However, another comparable study discovered a link between ability and academic success. Several studies have demonstrated significant disparities in learning performance between students of varying capacities (Hooper, 1992; Li, 2010; Tsai, 2000); however, the relationship between learning attitudes and learning performance among these students has not been established (Li, 2010; Tsai, 2000). Additionally, computer-assisted learning for high-ability student groups can facilitate the learning benefits for students (Kim, 2021). Based on the theoretical study above, the objectives of this study are (1) to investigate the mathematical academic abilities of students who learned using a Moodle-based blended-learning strategy; (2) examine the effect of the Moodle-based blended-learning strategy on students' mathematical academic abilities; (3) exploring the role of mathematical attitudes during the application of the Moodle-based blended-learning strategy.

METHODS

The present study aimed to investigate the impact of implementing a Moodle-based blended-learning strategy on students' mathematical academic ability and mathematical attitudes by combining semi-structured interviews with correlation analysis (Sharma & Gigras, 2017). This study employed an explanatory technique consisting of the analysis of quantitative data prior to qualitative data analysis (Creswell, 2012; Fraenkel, et al. 2011). The effect of the Moodle-based blended-learning strategy on students' mathematical academic abilities was analyzed quantitatively, while the effect of the strategy on students' mathematical attitudes was analyzed qualitatively.

In the experiment, the Moodle-based blended learning strategy served as the independent variable (X1), while the students' mathematical academic ability served as the dependent variable of this study (Y1). Figure 1 illustrates the schema of the relationship between the independent variable and the dependent variable in this study.

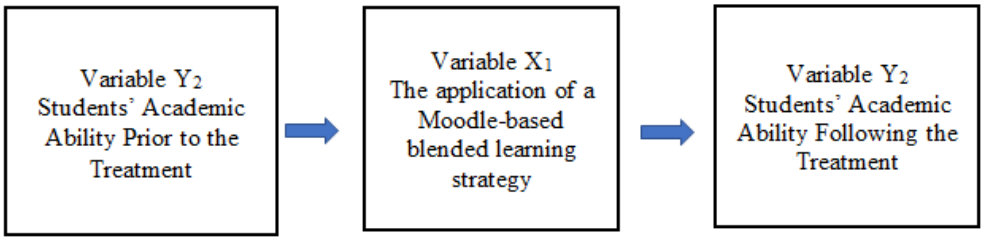

Fig. 1 Independent and Dependent Variables in this Study

Pre-Experimental One-Group Pretest-Posttest Design was employed, where a single experimental group was given a treatment (Table 1). Pretest was conducted before the treatment and post-test was conducted following the treatment.

Table 1 One grup pretest-posttest

Grup	Pretest	Treatment	Post-test
Exsperiment group	O_1	X	O_2

Notes:
X1 : a Moodle-based blended learning strategy
O1 : pretest
O2 : post-test

A pretest and a post-test were administered prior to and following the treatment to determine the changes or the increase in the research participants' understanding of mathematical concepts. The participants were chosen from junior high schools in Makassar. The population of the study consisted of eighty-four students (26 males and 59 females) with an average age of 14 years. However, this study's sample size was only twenty seven, comprised of 10 boys and 17 girls. Cluster random sampling was the sampling method used for this study. The sample class is one in which both teachers and students possess mobile devices and have access to the internet network. The procedure in this study was divided into 3 stages, namely the preparation stage, the implementation stage, and the data collection stage. In the preparation stage, we prepared lesson plans, Moodle as a learning medium in the online class, and data collection instruments, including student worksheets, teacher learning implementation sheets, and a test to measure students' academic abilities. In the preparation stage, we invited two peer observers and determined the research sample. The implementation stage included administering a pretest before the treatment, inviting students and observers into the classroom to observe learning activities, executing a Moodle-based blended learning strategy, administering a post-test following the implementation of the strategy. Students were allowed to ask questions to the teacher outside of class hours. They were also encouraged to express their difficulties during the implementation of the Moodle-based blended learning strategy. During the data collection phase, student learning activities and teacher learning implementation were observed. Written tests were administered at the beginning (pretest) and conclusion (posttest) of the study to collect data on students' mathematics academic achievement. Data related to students' mathematical attitudes were collected using an observation sheet containing indicators of mathematical attitudes that had been developed by previous researchers.

Research Instrument

The instruments in this study consisted of an observation sheet to evaluate the involvement of students' mathematical attitudes, an observation sheet to assess the implementation of learning using Moodle, a test sheet to measure students' mathematical academic abilities. The test sheet was given to the experimental class. The written test consists of five essay questions. Prior to conducting the study, the research instruments underwent a validation test by experts. The research instruments were used to collect qualitative and quantitative data. The qualitative data were obtained from teacher and student observations, whereas the quantitative data were gathered from an essay test.

Data Analysis

Data analysis in this study was performed using descriptive and inferential statistics.

RESULTS

The participants' initial knowledge of mathematics was examined through a pretest. The results of the descriptive analysis on students' pretest scores are presented in Table 2.

Table 2 Pretest-Posttest

Data	Pretest
The highest score	68
The lowest score	9
Mean	30.1111
Median	35.0000
Mode	41.00
Standard Deviation	16.35504
Variance	267.487

Based on Table 2, the highest and lowest scores achieved by the students were 68 and 9, respectively. The mean score reported by the students was 30.11, which is considered as very low. The median of the score was 35 and the mode was 41, indicating that most of the participants got a low score on the test. In addition, the test variance was 267.48 and the standard deviation was 16.35, suggesting that the data varied significantly, and that the data had small distribution.
Students' mathematical cognitive learning outcomes can also be presented in the form of frequencies and percentages, as shown in Table 3.

Table 3 The Frequency and Percentage of Students' Pretest Scores

Score	Pretest		Category
	Frequency	Percentage (%)	
<39	16	59.3	very poor
40 – 54	10	37.0	poor
55 – 74	1	3.7	medium
75 – 89	0	0	high
90 – 100	0	0	very high
Total	**27**	**100**	

Table 3 shows that more than half of the students (59.3%) obtained a very poor score on the pretest, none of them (0%) achieved a high or very high score on the pretest. The results of the students' cognitive mathematical ability following the implementation of a Moodle-based blended learning strategy are presented in Table 4.

Table 4 Pretest-Posttes Scores

Data	Posttest
The highest score	95
The lowest score	50
Mean	75.7778
Median	79.0000
Mode	71.00
Standard Deviation	13.29353
Variance	176.718

Table 4 indicates that the highest and lowest scores achieved by the students were 95 and 50, respectively. The mean score reported by the students was 75.77, which belongs to the high category. The median of the score was 79 and the mode was 71, indicating that most of the participants got a high score on the test. In addition, the test variance was 176.18 and the standard deviation was 13.29, suggesting that the data varied significantly, and that the data had small distribution. Students' mathematical academic ability can also be presented in the form of frequencies and percentages, as shown in Table 5.

Table 5 The frequency and percentage of students' posttest scores

Score	Pretest		Category
	Frequency	Percentage (%)	
<39	0	0	very poor
40 – 54	3	11.1	poor
55 – 74	9	33.3	medium
75 – 89	10	37.0	high
90 – 100	5	18.5	very high
Jumlah	**27**	**100**	

Based on Table 5, most of the students (37%) obtained a high score on the posttest and none of them (0%) achieved a low score. Hypothesis testing was conducted after ensuring that the data distributed normally. The hypothesis tested in this study was that the students showed a difference in mathematical ability following the implementation of a Moodle-based blended learning strategy. The test of the hypotesting was performed using the paired sample test with the assistance of SPSS 20. The results of the test are summarized in Table 6.

Table 6 The Hypothesis Testing Result

Paired Samples Test						
		Paired Differences		T	df	Sig. (2-tailed)
		Mean	Std. Deviation			
Pair 1	pretest - postest	-45.66667	12.49615	-18.989	26	.000

Based on Table 6, the significance value (0.000) was smaller than 0.05; hence H0 was rejected, indicated that the Moodle-based blended learning strategy had an effect on students' mathematical academic ability. Table 7 details the results of the paired samples test.

Table 7 Paired Samples Test

	Pretest / Posttest	Conclusion
Sig	0,000	Students' academic ability following the implementation of a Moodle-based blended learning strategy was different from that prior to the application of the strategy. After the implementation of the learning strategy, the students' academic ability improved significantly. It suggests that a Moodle-based blended learning strategy had a positive impact on students' mathematical academic ability.

The difference in the students' pretest and post-test scores are presented in Table 8.

Table 8 Group statistics

	Mean	N
Pretest	30.1111	27
Posttest	75.7778	27

Table 8 shows that the students' post-test mean score (75.7778) was significantly higher than their pretest score (30.1111). Therefore, it was concluded that the students achieved better in mathematics after using a Moodle-based blended learning strategy. N-Gain test was conducted to investigate the significance of the effect of the learning strategy on the experimental group. The N-Gain test was performed in SPSS. The test results can be seen in Table 9.

Table 9 N-gain Pretest-Posttest

Experimental group				
Re	Nilai		Gain	Category
	Pre	Post		
1	50.00	95.00	0.90	very high
2	41.00	87.00	0.78	very high
3	10.00	50.00	0.44	medium
4	41.00	71.00	0.51	medium
5	41.00	71.00	0.51	medium
6	40.00	70.00	0.50	medium
7	9.00	68.00	0.65	high
8	20.00	79.00	0.74	high
9	41.00	90.00	0.83	very high
10	35.00	68.00	0.51	medium
11	50.00	91.00	0.82	very high
12	19.00	71.00	0.64	high
13	38.00	85.00	0.76	high
14	22.00	85.00	0.81	very high
15	10.00	60.00	0.56	medium
16	35.00	86.00	0.78	high
17	18.00	71.00	0.65	high
18	41.00	87.00	0.78	high
19	13.00	80.00	0.77	high
20	32.00	80.00	0.71	high
21	9.00	51.00	0.46	medium
22	68.00	75.00	0.22	low
23	51.00	95.00	0.90	very high
24	13.00	60.00	0.54	medium
25	16.00	79.00	0.75	high
26	41.00	90.00	0.83	very high
27	9.00	51.00	0.46	medium

The pretest and post-test scores were then used in the N-Gain analysis assisted with SPSS 20. Table 10 contains the result.

Table 9 N-gain analysis

Category	N-Gain Frequency
very high	7
high	10
medium	9
low	1
very low	0
average	0.6591 (high)
number of students	27

Based on Table 10, the N-Gain score of the students' academic ability was high (0.6591). It suggests that the use of the Moodle-based blended learning strategy in the classroom had a significant effect on students' mathematical academic ability. The N-Gain analysis utilized th pretest and post-test mean scores of the students, which are 30.1111 and 75.7778, respectively.

DISCUSSION

The descriptive analysis of the students' pretest score revealed that 16 (59.3%) students achieved a very poor score and none of the students (0%) obtained scores in the very high or high category. However, following the implementation of a Moodle-based blended learning strategy, 10 (37.0%) participants reported scores in the high category and none of them

(0%) got a very low score. Observations indicate that prior to the implementation of blended learning, students tended to be less enthusiastic about the learning process because of teachers not using the appropriate tools to deliver lessons during the pandemic. The use of tools has always been integral to mathematical expression and calculation (Roberts et al., 2012). Numerous historical examples illustrate the capacity of tools to influence the evolution of mathematics as a scientific field (Laborde & Sträßer, 2010). Although "traditional" tools such as lectures, textbooks, and virtual learning environments (VLEs) are still used by undergraduates, non-institutional resources (e.g., social networking sites, instant messaging, online videos, search engines, and online encyclopedias) are an integral part of their education (Mark et al., 2011; Costa et al., 2016; Gallardo Echenique et al., 2015;Henderson et al., 2017 ;Judd & Kennedy, 2010; Thompson, 2013).

The hypothesis testing indicated a significance value (0.000) smaller than 0.05 which suggested that the H1 was accepted and H0 was rejected. Therefore, it was concluded that students' mathematical academic ability before the implementation of blended learning was different from that after blended learning. In addition, the N-Gain score of 0.6591 (high) also indicated that the use of Moddle as an application for learning had a positive impact on students' mathematical academic ability. This study concludes that in addition to using paper-based resources such as lecture notes, tutorial notes, and textbooks to learn mathematics, students also require learning tools. Twenty-four students enrolled in calculus and linear algebra modules at a Dutch university were interviewed by Kock & Pepin, (2018) who discovered that although the use of resources differs somewhat between the two modules, certain resources play a central role in students' everyday engagement with mathematics. These include the lecture, textbooks, the student's own notes, video-recorded lectures, online videos (such as YouTube), and human resources such as the lecturer/tutor and roommates. Kock & Pepin, (2018) concluded that although undergraduates build upon their secondary experiences, they must independently identify and coordinate the resources necessary to support their studies due to the difficulty of university mathematics. Similar results were reported by Ní Shé et al., (2017) who surveyed 394 first-year college students in Ireland. The majority of students (70%) used paper-based resources such as lecture notes, tutorial notes, and books, while more than half of them reported using online tools such as Khan Academy, YouTube, and Wolfram Alpha.

During the observation of students' attitudes toward mathematics, nearly every student's responses were positive. Initially, students were less enthusiastic about participating in learning because only the zoom application was used for online meetings. However, since the implementation of blended learning with the aid of Moodle as a learning platform, students had a tendency to exhibit greater enthusiasm. Similarly, previous research demonstrates that, in addition to face-to-face argumentation, an online learning environment has been used to engage students in science-related discussions and facilitate their learning (Clark et al., 2009; Joiner & Jones, 2003; Schellens & Valcke, 2006). As online asynchronous discussions give students time to read, reflect, and prepare typed responses, they would feel more at ease, be less aggressive, and have more opportunities to express their opinions (Tiene, 2000; Wang & Woo, 2007). (Hoadley & Linn, (2000) found that through asynchronous online discussion, students gain an integrated understanding of science concepts. Schellens & Valcke, (2006) claimed in a study that statistically analyzed coded discussion transcripts to test several hypotheses on knowledge construction that collaborative learning in asynchronous discussion enhanced task orientation and student knowledge construction. H. Lin et al., (2011) also reported that students' experiences analyzing and reflecting on ideas and comments in asynchronous online discussion contributed to the development of their conceptual comprehension. Collectively, research studies have highlighted the potential influence of online learning environments on student conceptual understanding.

In conclusion, a Moodle-assisted blended learning strategy had a positive impact on students' mathematical ability, because Moodle online forum provided students with opportunities for sharing and monitoring evidence resources, evidence, and claims produced by their colleagues from argument-based inquiry investigations of three classes, and allowed them to engage in challenging evidence resources, critiquing evidence, and negotiating claims. In their reflections on the online discussion, students indicated that the combination of the Moodle online forum and the in-class wrap-up discussion allowed them to evaluate, critique, and challenge the sufficiency, accuracy, reliability, and validity of evidence resources and evidence. According to Noroozi et al., (2012), a completely explicit argument for learners' knowledge construction in argumentation-based computer-supported collaborative learning (ABCSCL) would consist of a claim supported by reasons and a limitation on the claim's validity.

CONCLUSION AND IMPLICATIONS

The results of the study indicate that a Moodle-assisted blended learning strategy was effective in improving students' mathematical academic ability. The use of moodle as a learning platform had a positive impact on students' performance in mathematics, indicated by a high N-Gain score (0.6591). The use of Moodle as a learning medium can increase students' enthusiasm and engagement. Additionally, Moodle utilization promotes active learning and interaction between students and instructors in a learning environment. Although this research is limited to junior high school students and is based on a small sample, it provides clear evidence that students require effective media for post-covid-19 learning. In addition, this research is still extremely uncommon in published works. Therefore, it provides researchers, policymakers, and teacher educators with theory and comprehension regarding the use of Moodle as a learning platform that can increase students' interest and positive attitudes. Despite these limitations, the findings of this study provide mathematics educators and researchers with additional evidence of the importance of implementing innovative digital-based learning media in a post-pandemic mathematics learning environment in order to improve student academic achievement and mathematical attitudes.

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